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U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

REPORT NO. 1186

PROJECTILE ROTATING BANDS AND RELATED COMPONENTS

9th Partial Report

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COMPARISON OF OBTURATION EFFECTIVENESS OF  
ROTATING BANDS BY PHOTOGRAPHIC MEANS

FINAL Report                      Task  
Assignment MPG-Re3b-225-1-53

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NPG REPORT NO. 1186

Comparison of Obturation Effectiveness of  
Rotating Bands by Photographic Means  
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PART A

SYNOPSIS

1. A comparison was made of the obturation effectiveness of rotating bands of three rounds each from two guns; a 3"/70, whose recovered projectiles show marked erosion of the rotating bands, and a 3 1/2"/67 experimental weapon, whose projectiles show no such erosion. Care was taken to keep all conditions equal in both the weapon and recording apparatus. Projectile weight, propellant type, and muzzle velocity were the same in all firings.

2. It is concluded that:

a. Blow-by is present in firings of the 3 1/2"/67 caliber gun.

b. Insofar as can be established by the photographic technique used, there was no difference between the blow-by in the 3 1/2"/67 caliber gun and the 3"/70 caliber gun Type G Mod 7.

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Comparison of Obturation Effectiveness of  
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Comparison of Obturation Effectiveness of  
Rotating Bands of Photographic Means

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PART B

INTRODUCTION

1. AUTHORITY:

This test was conducted in accordance with reference (a) under Task Assignment NPG-Re3b-225-1-53.

2. REFERENCES:

- a. BUORD Rest ltr NP9 Re3b-MAS:mt of 1 April 1953
- b. NPG Rest Report No. 1109 of 1 April 1953

3. BACKGROUND:

Erosion of rotating bands on recovered projectiles from 3"/70 caliber guns has been noted frequently. Recovered projectiles from 3 1/2"/67 caliber experimental gun, however, show no such erosion. This observation led to a question as to whether there is any correlation between obturation effectiveness and band erosion. Prior studies of obturation, reported in reference (b), showed that a considerable amount of gas emerges ahead of the projectile during 3"/70 caliber gun firings. By reference (a), the Bureau of Ordnance requested comparative firings of 3"/70 and 3 1/2"/67 guns, using the technique described in reference (b), to learn whether blow-by at the muzzle is present when the bands are free from erosion.

4. OBJECT OF TEST:

The object of this test was to compare the obturation effectiveness of rotating bands fired from a 3"/70 gun with the effectiveness of similar bands in a 3 1/2"/67 gun, by means of high-speed photographs under controlled conditions.

5. PERIOD OF TEST:

- |                                   |               |
|-----------------------------------|---------------|
| a. Date of Letter Requesting Test | 1 April 1953  |
| b. Date Commenced Test            | 10 April 1953 |
| c. Date Firing of Test Completed  | 24 April 1953 |

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PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEM UNDER TEST:

Two barrels were fired from the same mount to obtain the necessary data for this test. These barrels were: Experimental gun, 3 $\frac{1}{2}$ "/67, Type A, Mod 0, (straight rifling) Serial No. 1, which had an E.S.R. of 170 and a 3"/70 gun, Type G, Mod 7, (disappearing rifling) Serial No. 24926 which had an E.S.R. of 667. The same powder, HKPC-1, was used in both barrels. The EX 1-0 projectile used in the 3 $\frac{1}{2}$ "/67 had the same nominal weight (15 lbs.) as the Mk 34 Mod 1, projectile used in the 3"/70 gun. The rounds for both calibers were loaded to give a muzzle velocity of 3400 feet per second. No sealing cups were used in this test.

7. DESCRIPTION OF TEST EQUIPMENT:

The high speed motion pictures were taken with a 16mm Fastax camera equipped with a 4" lens operating at 5800 frames per second. The operation of the camera was synchronized with the firing circuit by a special intervalometer.

8. PROCEDURE:

The two barrels, 3"/70 and 3 $\frac{1}{2}$ "/67, installed on the same mount in that order, were fired on the same day, within an hour of each other. The Fastax camera was set up perpendicular to the barrel axis and in line with the muzzle, about 50 feet away. Its position was not changed during the test.

Three rounds were fired from each barrel, with an average lapse of 10 minutes between rounds. The total firing time, including the barrel change, was about 1-1/2 hours. During this time the weather conditions did not change appreciably; therefore no change of exposure was expected.

Tape was secured near the muzzle of each barrel to identify it and also to serve as a scale. Both barrels were cold when the first round was fired. The mount was set at an elevation of 14 degrees throughout the firing. This provided an unobstructed background of clear sky behind the barrels.

The fact that this test was a comparison was considered throughout the preparation as well as the actual firing. All conditions were kept, as closely as possible, the same.

Comparison of Obturation Effectiveness of  
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9. RESULTS AND DISCUSSION:

a. The results of this test are shown in Appendix (A), Figures 1, 2, and 3. Each photograph shows two enlarged 16mm film strips, one of a round fired from the 3"/70 barrel and one of a round fired from the 3 1/2"/67 barrel. In each figure, corresponding rounds are compared. For example, the first round fired from the cold 3"/70, barrel is compared with the first round fired from the cold 3 1/2"/67 barrel. A line, perpendicular to the film strips, notes the time the nose of the projectile is in the muzzle plane. This position was determined by extrapolation from succeeding frames in which the projectile was visible, using the measurable ratio of muzzle velocity to frame rate.

b. The bases of comparison of the various rounds were the sizes and shapes of the cones of gas at corresponding times and the rate of growth in the period before ejection. The relative densities could not be used for purposes of comparison, because the average densities of the negatives were not sufficiently uniform.

c. The expected result of the test was that the 3 1/2" gun would yield significantly less blow-by than the 3"/70 gun. Close examination of the records obtained indicates that the blow-by in the 3 1/2" gun was equal to, if not very slightly greater than, that on the 3" gun; however, if any difference did exist, it was too small to be established definitely by the photographic method of comparison.

PART D

CONCLUSIONS

10. On the basis of these tests it is concluded that:

a. Blow-by is present in firings of the 3 1/2"/67 caliber gun.

b. Insofar as can be established by the photographic technique used, there was no difference between the blow-by in the 3 1/2"/67 caliber gun and the 3"/70 gun Type G Mod 7.



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Rotating Bands by Photographic Means  
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NPG REPORT NO. 1186

U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

Ninth Partial Report  
on  
Projectile Rotating Bands and Related Components

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Final Report  
on  
Comparison of Obturation Effectiveness of  
Rotating Bands by Photographic Means

Classification cancelled in accordance with  
Executive Order 10864 issued 5 November 1953.

*J. Diel*  
*8/4/54*

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24 April 1953

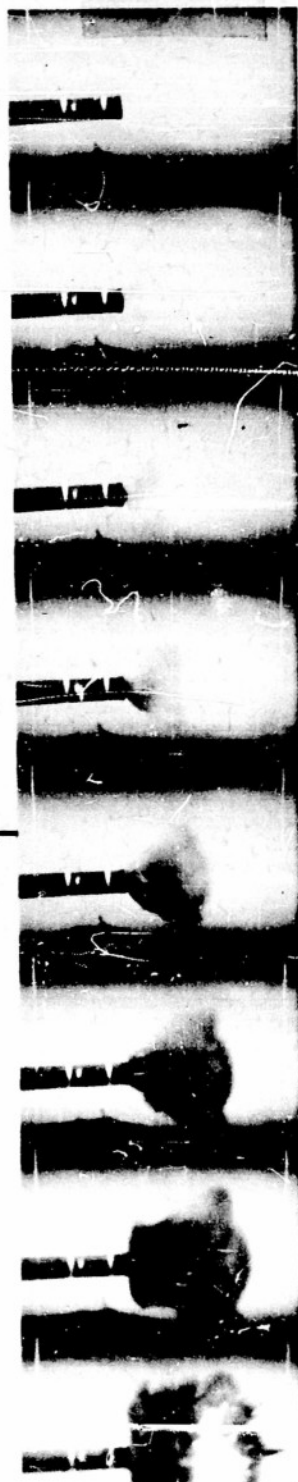
U. S. NAVAL PROVING GROUND

A Comparison of the Effectiveness in  
Obturation of Rotating Bands

3"/70 gun

Round No. 1  
(Cold gun)

Nose of Projectile  
passing Muzzle



3"/15/67

Round no. 1  
(Cold gun)

Nose of Projectile  
passing Muzzle

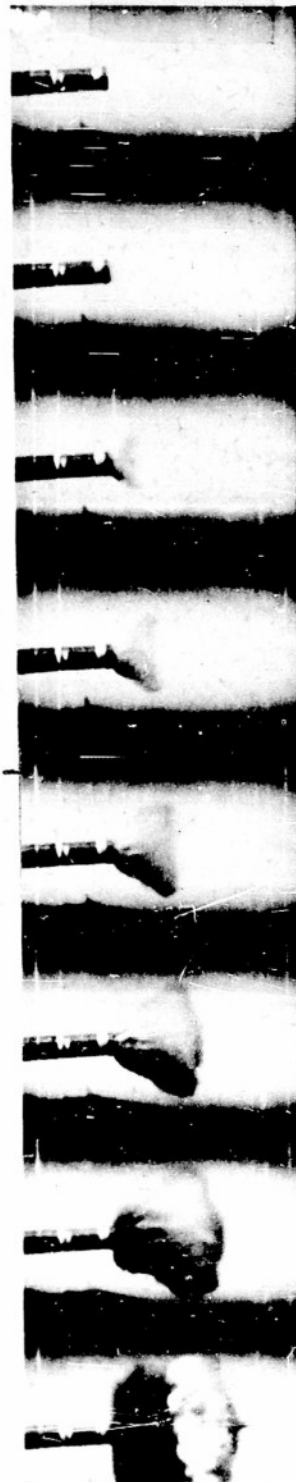


Figure 1

24 April 1953

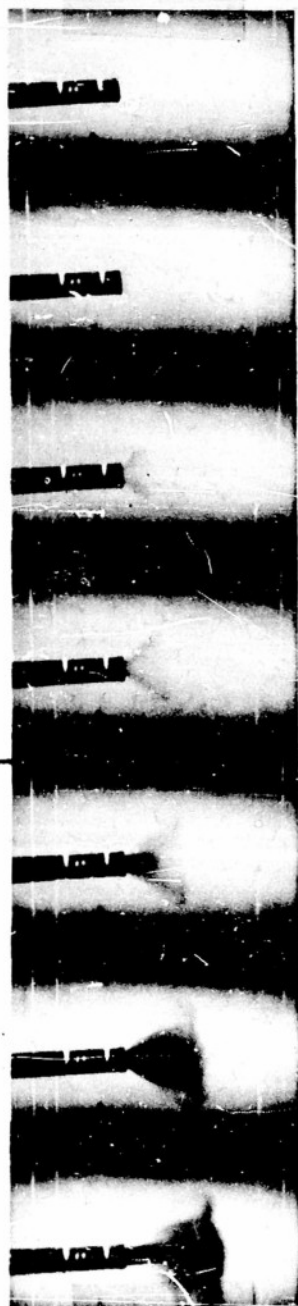
U. S. NAVAL PROVING GROUND

A Comparison of the Effectiveness in  
Obturation of Rotating Bands

3"/70

Round No. 2

Nose of Projectile  
passing Muzzle



3"15/67

Round No. 2

Nose of Projectile  
passing Muzzle

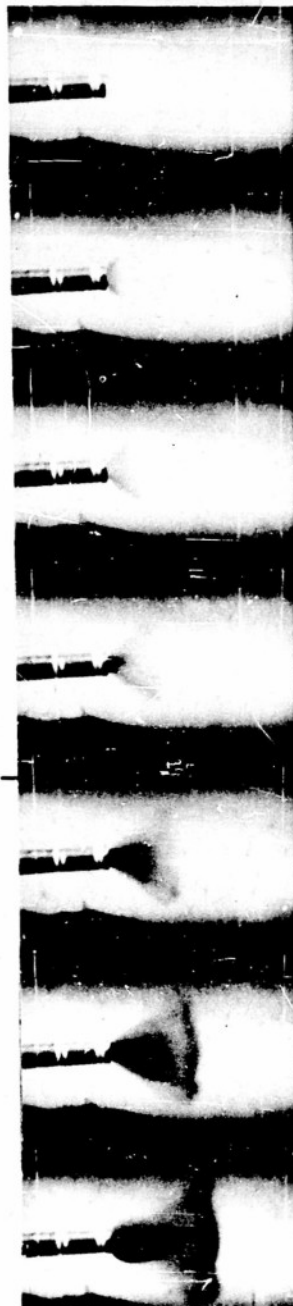


Figure 2

NP9-63471

U. S. NAVAL PROVING GROUND

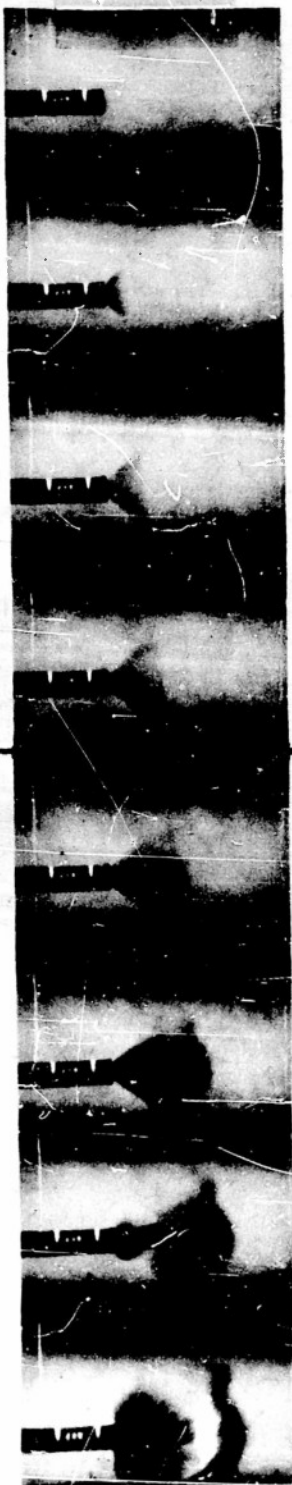
24 April 1953

A Comparison of the Effectiveness in  
Obturation of Rotating Bands

3"/70

Round No. 3

Nose of Projectile  
passing muzzle



3"15/67

Round No. 3

Nose of projectile  
passing Muzzle

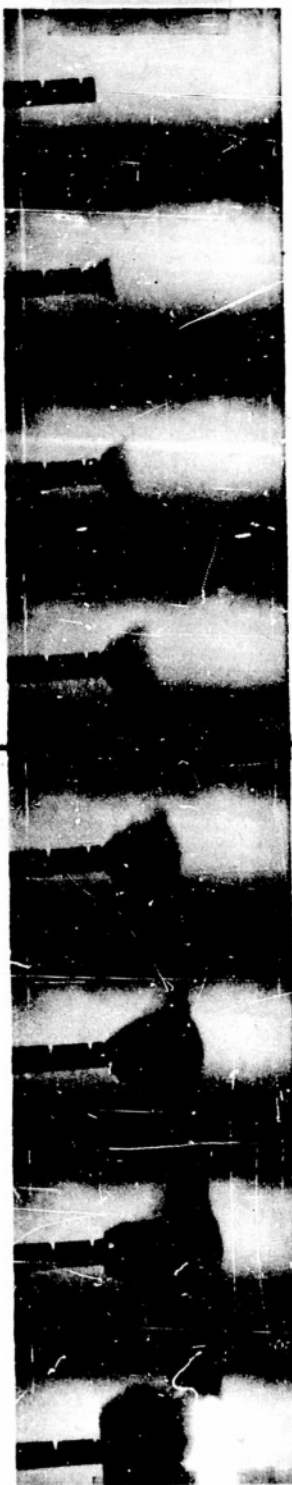


Figure 3

Comparison of Obturation Effectiveness of  
Rotating Bands by Photographic Means

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